

कंक्रीट के लिए हल्के भार वाला
कृत्रिम मिलावा — विशिष्टि

भाग 1 कंक्रीट चिनाई ब्लॉक और संरचनागत कंक्रीट
को छोड़ कर कंक्रीट के अन्य अनुप्रयोगों के लिए मिलावा
(पहला पुनरीक्षण)

**Artificial Lightweight Aggregate
for Concrete — Specification**

Part 1 For Concrete Masonry Blocks and for
Applications Other than for Structural Concrete

(First Revision)

ICS 91.100.30

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

One of the methods of producing lightweight concrete is by using lightweight aggregates. The essential characteristic of lightweight aggregate is its high porosity which results in a low apparent specific gravity. Some lightweight aggregates occur naturally and others are manufactured.

This standard was first published in 1979. This revision has been brought out to incorporate the modifications found necessary in the light of experience gained in its use and also to bring it in line with the latest developments on the subject.

In this revision, the standard is being brought out in two parts. The other part in the series is:

Part 2 Sintered fly ash coarse aggregate

This standard (Part 1) specifies the requirements of foamed blast furnace slag aggregate, bloated clay aggregate, and cinder aggregate as artificial lightweight aggregates.

Significant modifications in this revision include,

- a) a detailed table regarding the maximum bulk density of various types of aggregates have been incorporated;
- b) the grading requirements for artificial lightweight coarse aggregates have been modified, and a note has been introduced for the users of the aggregates mentioning that artificial lightweight fine aggregate can be used subject to combined grading conforming to Table 2;
- c) the permissible percentage of deleterious substances have been modified; and
- d) the requirement of drying shrinkage has been updated.

This standard contains **11.1** which call for agreement between the purchaser and the manufacturer.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that specified value in this standard.

Indian Standard

ARTIFICIAL LIGHTWEIGHT AGGREGATE FOR CONCRETE — SPECIFICATION

PART 1 FOR CONCRETE MASONRY BLOCKS AND FOR APPLICATIONS OTHER THAN FOR STRUCTURAL CONCRETE

(First Revision)

1 SCOPE

1.1 This standard covers the requirements of artificial lightweight aggregates, namely foamed blast furnace slag, bloated clay aggregate, and cinder aggregate intended for use in concrete masonry units and for applications other than structural concrete, in which prime consideration is lightness in mass.

1.2 This standard does not cover sintered fly ash coarse aggregates, which is covered in IS 9142 (Part 2).

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
269 : 2015	Ordinary Portland cement — Specification (<i>sixth revision</i>)	2430 : 1986	Methods for sampling of aggregates for concrete (<i>first revision</i>)
383 : 2016	Coarse and fine aggregate for concrete — Specification (<i>third revision</i>)	2686 : 1977	Specification for cinder aggregates for use in lime concrete (<i>first revision</i>)
1199 (Part 5) : 2018	Method of sampling and analysis of fresh concrete: Part 5 Making and curing of test specimens (<i>first revision</i>)	4032 : 1985	Method of chemical analysis of hydraulic cement (<i>first revision</i>)
2386	Methods of test for aggregates for concrete	4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)
(Part 1) : 1963	Particle size and shape	9142 (Part 2) : 2018	Artificial lightweight aggregate for concrete — Specification: Part 2 Sintered fly ash coarse aggregate (<i>first revision</i>)
(Part 2) : 1963	Estimation of deleterious materials and organic impurities		
(Part 3) : 1963	Specific gravity, density, voids, absorption and bulking		

3 GENERAL CHARACTERISTICS

3.1 General types of artificial lightweight aggregates covered by this standard are as follows:

- a) Aggregates prepared by expanding, pelletizing, or sintering products such as blast furnace slag, clay, or shale; and
- b) Cinder aggregates conforming to Class C of IS 2686. Cinder aggregate is a kind of industrial waste slag lightweight aggregate made of coal gangue left during coal mining and dressing by stacking, spontaneous igniting, crushing and sieving.

3.2 The aggregates shall be composed predominantly of lightweight cellular and granular inorganic material.

4 BULK DENSITY

4.1 Maximum dry loose bulk density of lightweight aggregates shall conform to the

requirements in Table 1.

**Table 1 Maximum Bulk Density (Loose)
Requirements of Artificial Lightweight Aggregates
(Clause 4.1)**

Sl No.	Size Designation	Maximum Dry Loose Bulk Density kg/m ³
(1)	(2)	(3)
i)	Fine aggregate	1 150
ii)	Coarse aggregate	950
iii)	Combined fine and coarse aggregate	1 100

4.2 Uniformity of Mass

The bulk density of successive supplies of lightweight aggregate shall not differ by more than 10 percent from that of the sample submitted for acceptance tests.

5 GRADING

The grading of the aggregate, that is, its particle size distribution as obtained by sieve analysis shall be as given in Table 2.

6 DELETERIOUS SUBSTANCES

Lightweight aggregates shall not contain excessive amounts of deleterious substances, as determined by the limits described in 6.1 to 6.3.

6.1 Organic Impurities

Lightweight aggregates, upon being subjected to the test for organic impurities that produce a colour darker than the standard colour shall be rejected, unless it can be demonstrated that the discolouration is due to small quantities of materials not harmful to the concrete.

6.2 Clay Lumps

The amount of clay lumps shall not exceed 1 percent by dry mass.

6.3 Loss on Ignition

Loss on ignition of aggregates shall not exceed 5 percent by dry mass. For cinder aggregates, loss on ignition shall be as specified in IS 2686.

7 CONCRETE MAKING PROPERTIES

Concrete specimens containing lightweight aggregate, when tested, shall meet the requirements specified in 7.1 and 7.2.

7.1 Drying Shrinkage

The drying shrinkage of concrete specimens prepared and tested in accordance with 8.7 shall not exceed 0.35 percent.

7.2 Sulphate Content

The sulphate content of lightweight aggregate shall not be more than one percent when expressed as sulphuric anhydride (SO_3) by mass.

Table 2 Grading Requirements for Artificial Lightweight Aggregates

(Clause 5)

Sl No.	IS Sieve Designation	Percentage Passing (by mass) of IS sieves			
		Fine Aggregate (Below 4.75 mm)	Coarse Aggregate		Combined Fine and Coarse Aggregate (below 10 mm) (see Note)
			(12.5 to 4.75 mm)	(10 to 2.36 mm)	
(1)	(2)	(3)	(4)	(5)	(6)
i)	20 mm	—	100	—	—
ii)	12.5 mm	—	90-100	100	100
iii)	10 mm	100	40-85	85-100	90-100
iv)	4.75 mm	85-100	0-20	0-40	65-90
v)	2.36 mm	—	0-10	0-15	35-65
vi)	1.18 mm	40-80	—	—	—
vii)	600 μm	—	—	—	—
viii)	300 μm	10-35	—	—	10-25
ix)	150 μm	—	—	—	—

NOTE — Any artificial lightweight fine aggregate may be used, subject to combined grading conforming to table.

8 METHODS OF SAMPLING AND TESTING

8.1 Sampling

The sampling of lightweight aggregates shall be done in accordance with IS 2430.

8.2 Grading

Grading of sample of lightweight aggregate shall be done in accordance with the provisions given in IS 2386 (Part 1).

8.3 Bulk Density (Loose)

The lightweight aggregate shall be tested in oven-dry conditions according to the requirements given in IS 2386 (Part 3).

8.4 Organic Impurities

The lightweight aggregate shall be tested in accordance with IS 2386 (Part 2).

8.5 Clay Lumps

Clay lumps in lightweight aggregate shall be determined as described in IS 2386 (Part 2).

8.6 Loss on Ignition

Loss on ignition of aggregates shall be determined on crushed sample passing 150 microns IS sieve by the method described in 4.2 of IS 4032, as per the procedure applicable for cement.

NOTE — For the purpose of testing, wherever reference to cement has been made in IS 4032, it may be read as aggregate.

8.7 Drying Shrinkage

8.7.1 Casting of Specimen

Prepare a concrete mix proportion of one part ordinary Portland cement conforming to IS 269, to six parts combined aggregates (2 parts of natural fine aggregate conforming to Zone II of IS 383 and 4 parts of graded lightweight coarse aggregate conforming to Table 1 of IS 9142 (Part 2) measured by dry loose volume. Adjust the water content so as to produce a slump of 50 to 100 mm. Thoroughly consolidate the concrete in steel prism bar mold 75 mm × 75 mm × 300 mm. The surface of the concrete shall be steel-troweled.

NOTE — Lightweight coarse aggregate shall be used in saturated surface dry condition while making concrete specimen.

8.7.2 Curing and Testing of Specimen

The specimen shall be cured and tested in accordance with procedure given in IS 1199 (Part 5).

8.7.3 Report

Report the change in length as the drying shrinkage of the specimen. Report the average drying shrinkage of three specimens as the drying shrinkage of concrete.

8.8 Sulphate Content

The sulphate content of the aggregate shall be determined on crushed sample passing 150 microns IS sieve by the method described in 4.9 of IS 4032, as per the procedure applicable for cement

NOTE — For the purpose of testing, wherever reference to cement has been made in IS 4032, it may be read as aggregate.

9 REJECTION

Material that fails to conform to the requirement of this specification shall be subject to rejection. The reason of rejection shall be reported to the producer or supplier promptly and in writing.

10 SUPPLIER'S CERTIFICATE AND COST OF TESTS

10.1 The supplier shall satisfy himself that the material complies with the requirements of this standard and, if requested, shall supply a certificate to this effect to the purchaser.

10.2 If the purchaser requires independent tests to be made, the sample for such tests shall be taken before or immediately after delivery, according to the option of the purchaser and the tests carried out in accordance with this standard and on the written instructions of the purchaser.

10.3 The supplier shall supply free of charge the material required for tests.

10.4 The cost of tests carried out under **10.2** shall be borne by,

- the supplier, if the results show that the material does not comply with this standard; and
- the purchaser, if the results show that the material complies with this standard.

11 DELIVERY

11.1 Supplies of aggregate may be made in bulk in suitable quantities mutually agreed upon between the purchaser and the supplier. Where so required by the purchaser, the aggregate may be supplied in bags (jute, jute-laminated, polyethylene lined or as may be mutually agreed to between the purchaser and the supplier) bearing the net quantity (may be 15 kg, 30 kg, 300 kg, 600 kg or as agreed to between the purchaser and the supplier). The tolerance on the quantity of aggregate in each bag or consignment shall be as per **11.2** unless mutually agreed upon between the purchaser and the supplier.

11.2 Tolerance Requirements for the Quantity of Aggregate Packed in Bags

11.2.1 The average of net quantity of aggregate packed in bags at the plant in a sample shall be equal

to or more than 25 kg, 50 kg, 300 kg, 600 kg, etc, as applicable. The number of bags in a sample shall be as given below:

<i>Batch Size</i> (1)	<i>Sample Size</i> (2)
100 to 150	20
151 to 280	32
281 to 500	50
501 to 1 200	80
1 201 to 3 200	125
3 201 and over	200

The bags in a sample shall be selected at random (*see IS 4905*).

11.2.2 The number of bags in a sample showing a minus error greater than 2 percent of the specified net quantity shall be not more than 5 percent of the bags in the sample. Also the minus error in none of such bags in the sample shall exceed 4 percent of the specified net quantity of aggregate in the bag.

11.2.3 In case of a wagon or truck load of 5 to 25 t, the overall tolerance on net quantity of aggregate shall be 0 to + 0.5 percent.

12 MARKING

12.1 Each consignment/bag of aggregate shall be legibly and indelibly marked with the

following information:

- a) Manufacturer's name and his registered trademark, if any;
- b) Net quantity, in kg;
- c) Words 'Use no Hooks' on the bags;
- d) Batch/control unit number;
- e) Address of the manufacturer;
- f) Month and year of consignment/packing;
- g) Type of aggregate, such as 'Coarse Aggregate' or 'Fine Aggregate' or 'Combined Coarse and Fine Aggregate';
- h) In case of coarse aggregates, the size of the aggregate '12.5 to 4.75 mm' or '10 to 2.36 mm'; and
- j) Type of aggregate based on nature of aggregate, such as 'Foamed Blast Furnace Slag Aggregate' or 'Bloated Clay Aggregate' or 'Cinder Aggregate'.

12.2 Similar information shall be provided in the delivery advices accompanying the shipment of aggregate in bulk (*see 12.3*).

12.3 BIS Certification Marking

The aggregate may also be marked with the Standard Mark.

12.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 02

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